OPINION

On the future of science and its wise pursuit

Science's endless frontier is a changing frontier. It requires a dynamic approach to governance, collaboration, and investment.

By Vinton Cerf and France Córdova

How does the world work? What is life? How did it come about on Earth? How did the universe start? Will the universe end? If so, how? Are there multiple universes? Why do things work the way they do and not some other way? These and myriad other questions permeate the history of human thought. We are curious by nature. And we have developed over time the methods of science to formulate and find answers to such fundamental questions.

We humans are not alone in our curiosity. The problem-solving capacity that ants, termites, squirrels, birds, and beavers exhibit suggests that we are not the only species with the incentive to learn and understand, but we are likely unique in our thirst to know for the sake of knowing.

In 1945, Vannevar Bush, director of the US Office of Scientific Research and Development, submitted a report to President Harry Truman titled *Science: The Endless Frontier*, in which he made a compelling case for strong government investment in basic research. World War II had demonstrated the vital importance of basic and applied science. The postwar period has reinforced the societal and economic benefits of continuing to encourage and support scientific research for the benefit of all humanity.

The argument that Bush made for the support of scientific research is as compelling today as it was 80 years ago. History has shown that a healthy research system supports curiosity-driven discovery, mission-driven research, translation into practice, and application; benefits from multiple contributors, including academia, industry, philanthropy, and government; and depends on attracting talent and exchanging ideas across borders.

An extraordinary moment

We are currently witnessing a profound transformation in the scientific enterprise. Fueled by the emergence of extremely powerful new research tools, the opportunity for advancing knowledge has never been brighter. And the pace of change has never been faster.

Large-scale computing and information aggregation, especially in the form of AI large language models, have increased by orders of magnitude our ability to assemble, organize, share, and apply scientific knowledge in the search for answers to both fundamental and applied questions. By helping researchers explore concepts, articulate questions, design experiments, analyze data, and interpret results, these systems are opening up new methods of discovery and understanding and are producing breakthroughs in biology, chemistry, physics, mathematics, astronomy, and other areas. Adding to this capability are AI-based agents that we can interact with cogently using prompts that feel increasingly like normal human dialogue.

The paradox of this extraordinary moment is that powerful tools by themselves do not guarantee scientific progress. Discovery depends on talented (and wise!) people with the freedom to pursue important questions, on institutions capable of sustained inquiry over long periods, on shared research infrastructure, and on funders willing to support ideas whose eventual applications cannot be foreseen. The challenge is larger than determining how to deploy new technologies. It is figuring out how to steward a scientific enterprise to use them effectively.

There could not be a more opportune time to engage in serious discussion on how best to focus these capabilities on problems of vital importance to current society. All of society can benefit from the collaborative sharing of knowledge and capacity to conduct scientific research. Historically, prescient US government investment in universities combined with private-sector initiatives and philanthropic endeavors have fueled the rapid advance of scientific progress. This has been an unbeatable trifecta that for decades has delivered discovery, innovation, and economic benefit. Given the new tools at our disposal, the time is thus ripe to double down on continued cooperative research initiatives.

NSF pioneered the concept of public–private cooperative agreements that accelerate technology transfer into the private sector. Recognizing the power of those

relationships, the agency in 2022 created the Technology, Innovation, and Partnerships directorate, which is devoted especially to crafting such agreements to speed the transformation of research results into practice. It complements NSF's foundational role in curiosity-driven research and expands the potential for society to benefit from that research.

Yet at precisely the moment when the opportunities for scientific discovery are expanding dramatically, the institutional capacity that has enabled US science to seize such opportunities is under strain. The continued strength of the scientific enterprise therefore depends not only on new investments and new partnerships but also on sustaining the public institutions that provide continuity, scale, shared infrastructure, and support for curiosity-driven research whose value may not be apparent for decades.

Embarking on a new dialogue

As we look toward the future of scientific endeavor, it becomes clear that the world of science is changing too rapidly for the infrequent assessments that take place in various fields to keep up. What is needed is a new, persistent, and comprehensive dialogue on research opportunities: a continuing conversation about how best to sustain, strengthen, and adapt the scientific enterprise. The two of us thus envision annual convenings dedicated to that dialogue. Such a forum would provide a means to continually assess whether the architecture that supports science—the partnerships between government, academic, industrial, and philanthropic sectors—is keeping pace with science itself. The structures that support science must be capable of responding dynamically to changing opportunities and needs.

The questions before all of us are unlikely to yield a single or permanent answer. The tools for scientific discovery and the resulting impact are changing rapidly. That presents a challenge to the institutions that support it. How should government, universities, industry, and philanthropies respond? What can each sector uniquely do, and what becomes possible when their strengths are combined?

We envision this new forum as the beginning of that conversation, a conversation to be renewed each year as opportunities, challenges, and responsibilities evolve. An endless frontier is a changing frontier. It requires a dynamic approach to governance, collaboration, and investment. PT

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RICE

FACULTY POSITION IN ASTRONOMY, ASTRO-PARTICLE PHYSICS AND COSMOLOGY

The Department of Physics and Astronomy at Rice University in Houston, Texas, invites applications for a tenure-track faculty position as part of an AI Initiative hire. Candidates must demonstrate expertise in at least one key emerging area, such as generative AI, agentic systems, or physical AI, extending beyond traditional machine learning tools. They should possess the ability to develop advanced computational frameworks, physics-informed AI methodologies, or innovative algorithmic tools, and integrate them into theory, simulation, data analysis, or instrumentation pipelines. Successful candidates will focus their research program on one or a subset of the following areas: star-planet interactions, exoplanetary science, astro-particle physics, or cosmology.

Depending on the exact expertise of the final hire, the hire will be required to measurably strengthen connections between the Nuclear and Particle Physics group and the Relativistic Astrophysics and Cosmology group, or between the Space Plasma Physics and Astrophysics of Star and Planet formation groups. Ultimately, this hire will foster interdisciplinary collaboration, establish a shared AI ecosystem across domains, and build connections with the Ken Kennedy Institute, the Rice Space Institute, and the T.W. Bonner Laboratory. We seek outstanding scientists whose research will complement and extend existing activities within the Department and across the University. In addition to developing an independent and vigorous research program, the successful applicant will be expected to teach, on average, one undergraduate or graduate course each semester, playing a critical role in integrating modern AI concepts systematically throughout our curricula to train the next generation of scientists fluent in AI-enabled discovery, and contribute to the service missions of the Department and University. The Department anticipates making an appointment at the assistant professor level. A Ph.D. in physics, astronomy, or a related field is required by the time of appointment.

Applications for this position must be submitted electronically at **https://apply.interfolio.com/195430**. Applicants will be required to submit the following: (1) cover letter; (2) curriculum vitae; (3) statement of research; (4) statement on teaching; (5) PDF copies of up to three publications; and (6) the names, affiliations, and email addresses of three professional references. We welcome the fullness of diversity to Rice. Qualified applicants are considered without regard to race, color, religion, age, sex, sexual orientation, gender identity, national or ethnic origin, genetic information, disability, or protected veteran status. Also, in our candidate pools, we seek to attract greater representation of women, scholars of color, people with disabilities, veterans, and others who have historically been underrepresented in Physics. We will begin reviewing applications by December 1, 2026. To receive full consideration, all application materials must be received by December 10, 2026. The anticipated start date is July 1, 2027.